November 26, 2014

INDEPENDENT REVIEW OF 2014 DAM SAFETY INSPECTION REPORT

Giant Nickel Tailings Dams

Submitted to:
Barrick Gold Inc.
PO Box 788
Penticton, BC
V2A 6Y7

Attention: Robbin Harmati

REPORT

Reference Number: 1412161-003-R-Rev1-2000

Distribution:

1 Electronic Copy - Barrick Gold Inc.
2 Hard Copies - Barrick Gold Inc.
2 Hard Copies - Golder Associates Ltd.

Golder Associates

Executive Summary

Golder Associates Ltd. (Golder) was engaged by Barrick Gold Inc. (Barrick) to perform an independent review of the 2014 Dam Safety Inspection report for Giant Nickel Mine, BC, produced by Knight Piesold Ltd. (KP). The review work was commissioned on September 23, 2014, in response to Golder's proposal P1412161-001-P-Rev0.

The independent review was required based on the *Notification of Chief Inspector's Orders – Tailings Dams – Independent Review of Dam Safety and Consequence Classification* from the British Columbia Ministry of Energy and Mines (BC MEM) dated August 18, 2014 (BC MEM 2014).

The scope of the review included the following:

- site visit by Mr. John Hull, P. Eng., on October 21, 2014, to observe the condition and status of the tailings dams; and
- review of the draft 2014 Dam Safety Inspection (DSI) report produced by KP, reference VA101-93/4-1 Rev. A, dated September 30, 2014 (KP 2014).

The findings of Golder's review are as follows:

- The DSI report prepared by KP generally addresses the elements required by the BC MEM (2012). However, there is no review of the 2014 climate data in the area of the tailings facility and a water balance was not developed based on the 2014 climate information.
- The dam consequence classification appears appropriate.
- The report provides a clear documentation of the status of the tailings dams.

The following actions are recommended:

- Barrick should review the water management strategy and management of the spillways.
- The facility should be reviewed to reflect the new guidance for closed – passive care sites from the Canadian Dam Association (CDA 2014).
- A Dam Safety Review should be completed in 2015.

Study Limitations

Golder Associates Ltd. (Golder) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, has been prepared by Golder for the sole benefit of Barrick Gold Inc. (Barrick). It represents Golder's professional judgement based on the knowledge and information available at the time of completion. Golder is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to Golder by Barrick, and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this document, reference must be made to the entire document.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder. Barrick may make copies of the document in such quantities as are reasonably necessary for those parties conducting business specifically related to the subject of this document or in support of or in response to regulatory inquiries and proceedings. Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic media versions of this document.

Table of Contents

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was engaged by Barrick Gold Inc. (Barrick) to perform an independent review of the 2014 Dam Safety Inspection (DSI) report for Giant Nickel Mine, BC, produced by Knight Piesold Ltd. (KP). The work was commissioned on September 23, 2014, in response to Golder's proposal P1412161-001-P-Rev0.

The independent review was required based on the *Notification of Chief Inspector's Orders – Tailings Dams – Independent Review of Dam Safety and Consequence Classification* from the British Columbia Ministry of Energy and Mines (BC MEM) dated August 18, 2014 (BC MEM 2014). This order states:

> *The mine manager must have the DSI reviewed by an independent qualified third party professional engineer from a firm that has not been associated with the tailings dam. The Independent Third Party Review of the DSI must also include a review of the dam consequence classification.*

The scope of the review included the following:

- site visit by Mr. John Hull, P. Eng., on October 21, 2014, to observe the condition and status of the tailings dams; and
- review of the draft 2014 DSI report produced by KP reference VA101-93/4-1 Rev. A, dated September 30, 2014 (KP 2014).

The independent review is not a Dam Safety Review as defined in the *Dam Safety Review Guidelines* produced by the BC Dam Safety Section (BC MEM 2012), in Section 5 of the Canadian Dam Safety Guidelines produced by the Canadian Dam Association (CDA 2013), and in the *Professional Practice Guidelines – Legislated Dam Safety Reviews in BC* produced by the Association of Professional Engineers BC (APEGBC 2014).

2.0 BACKGROUND

2.1 Site Description

Giant Nickel Mine (Giant Nickel) was an underground mine operation located 8 km north of Hope and 2 km west of the Fraser River in southwest British Columbia. The mine is located in mountainous terrain of the coastal mountains. The tailings facility layout is shown in Figure 1.

The mine includes the tailings facilities and tailings dams as shown in Table 1.

Table 1: Summary of Giant Nickel Tailings Dams

Impoundment	Tailings Dam	Status/Comments
Upper Tailings Pond	Upper Tailings Dam Upper Berm and Lower Berm	The pond is closed and a till cap has been placed on the surface of the pond.
Lower Tailings Pond	Lower Tailings Dam	The pond is closed and a till cap has been placed over the tailings surface. A small pond is present adjacent to the dam and stores runoff water from the lower tailings basin area.

2.2 Design Consultant

The original design consultant for Giant Mascot Mines (now Giant Nickel) was Golder, Brawner and Associates in the 1970s. The mine is now owned by Barrick and the design consultant is understood to be KP.

The preparation of this report by Golder does not impact the design consultant role held by KP.

3.0 INDEPENDENT REVIEW OF DAM SAFETY INSPECTION REPORT

3.1 Compliance with Ministry of Energy and Mines Requirements

The requirements for DSIs are presented in *Guidelines for Annual Dam Safety Inspection Reports* (BC MEM 2012). Table 2 summarizes the compliance or otherwise of the KP DSI report (KP 2014) with the BC MEM requirements.

Table 2: Compliance of Dam Safety Inspection Report with British Columbia Ministry of Energy and Mines Dam Safety Inspection Requirements

Requirement	Included	Comment
Executive Summary Classification of the dam(s) in terms of Consequence of Failure in accordance with Table 2-1 of the CDA Dam Safety Guidelines (2013).	✓	Very High
a. Significant changes in instrumentation and/or visual monitoring records.	✓	
b. Significant changes to dam stability and/or surface water control.	✓	
c. For major impoundments, as defined in Part 10 of the Code, a current Operation, Maintenance and Surveillance (OMS) Manual is required. The annual report shall indicate the latest revision date of the OMS manual.	✓	September 2014
d. For tailings dams classified as High, Very High, or Extreme Consequence, an Emergency Preparedness Plan (EPP) is required. The annual report shall indicate the latest revision date of the EPP document.	✓	September 2014
e. Scheduled date for the next formal Dam Safety Review in accordance with Table 5-1 of the CDA Dam Safety Guidelines (2013). Formal Dam Safety Reviews are required every 5 to 10 years (depending on consequence classification) and differ from annual dam safety inspections. The requirements for Dam Safety Reviews are included in Section 5 of the CDA Dam Safety Guidelines. Dam Safety Reviews may be conducted by the Engineer of Record with third party review, or by an independent third party with involvement of the Engineer of Record.	✓	2015
Summary of past years' construction (if any) with a description of any problems and stabilization	✓	
Plan and representative cross-sections	✓	
Site photographs	✓	
Review of climate data	x	No review of 2014 climate data
Water balance review	x	No water balance based on current configuration or present pond in Lower TMF
Freeboard and storage availability (in excess of the design flood)	✓	
Water discharge system, volumes, and quality	✓	Water quality reported by Barrick
Seepage occurrence and water quality	✓	No seepage noted
Surface water control and surface erosion	✓	
Instrumentation review including: (a) Phreatic surfaces and piezometric data. (b) Settlement. (c) Lateral movement.	✓	No instrumentation is in the dams to monitor phreatic surfaces, settlement, or lateral movement.

3.2 Dam Consequence Classification

Tailings dams in British Columbia are regulated under the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEMPR 2008), which references Canadian Dam Association (CDA) *Dam Safety Guidelines* (CDA 2007). The CDA (2007) dam consequence classification system is consistent with the revised CDA guidelines (CDA 2013).

Consequence categories are based on the incremental losses that a failure of the dam might inflict on downstream or upstream areas, or at the dam location itself. Incremental losses are those over and above losses that might have occurred in the same natural event or condition had the dam not failed. The classification assigned to a dam is the highest rank determined among the four loss categories.

Table 3 presents the dam classification criteria by CDA (2013).

Table 3: Dam Classification in Terms of Consequences of Failure

Dam Class	Population at Risk[a]	Incremental Losses		
		Loss of life[b]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short term loss. No long term loss.	Low economic losses; area contains limited infrastructure or service.
Significant	Temporary Only	Unspecified	No significant loss or deterioration of fish or wildlife habitat. Loss of marginal habitat only. Restoration or compensation in kind highly possible.	Losses to recreational facilities, seasonal workplaces, and infrequently used transport routes.
High	Permanent	10 of fewer	Significant loss or deterioration of important fish or wildlife habitat. Restoration or compensation in kind highly possible.	High economic losses affecting infrastructure, public transport, and commercial facilities.
Very High	Permanent	100 of fewer	Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).
Extreme	Permanent	More than 100	Major loss of critical fish or wildlife habitat. Restoration or compensation in kind impossible.	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances).

Source: CDA (2013).

a) Definition for population at risk:
None – There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.
Temporary – People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing through on transportation routes, participating in recreational activities).
Permanent – The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).

b) Implications for loss of life:
Unspecified – The appropriate level of safety required a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.

CDA = Canadian Dam Association.

A dam breach study (in progress) indicates that a breach would have significant impact on several dwellings below the facility beside Stulkawhits Creek and on the nearby Highway 1 and the CN Main line railway. In addition, given the proximity of the Fraser River, it is anticipated that for a potential dam failure, tailings and failure debris would reach the Fraser River and result in significant negative impacts to fish habitat.

The potential impacts on life (dwellings beside Stulkawhits Creek), loss of infrastructure (highway and railway), and fish habitat are estimated to be in the range covered by the High or Very High consequence categories. Given the potential loss of infrastructure and risk to human life, the consequence classification is likely to be dominated by population at risk. On this basis, the dam classifications of the Giant Nickel tailings dams are assessed as shown in Table 4.

Table 4: Dam Consequence Classifications

Dam	Population at Risk	Incremental Losses		Dam Consequence Classification
		Environmental and Cultural Values	Infrastructure and Economics	
Upper Tailings Dam	Permanent 10 to 100	Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	High to very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).	Very High
Lower Tailings Dam	Permanent 10 to 100	Significant loss or deterioration of critical fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	High to very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).	Very High

The consequence classification is consistent with that assigned by KP (2014).

The dam consequence classification typically influences the selection of the return periods for earthquake and design flood events and the frequency for Dam Safety Reviews. The 2014 DSI (KP 2014) indicates the Giant Nickel dams have been checked this year using the proposed design earthquake and flood events that satisfy the new CDA criteria for closure – passive care facilities (CDA 2014) and the dams are considered Very High consequence dams. The review indicates that dams may satisfy the classification for seismic events, but may require upgrades for closure – passive care flood events.

Knight Piesold Ltd. recommends that the dams and water management features be re-evaluated to confirm the 2014 DSI assessment (KP 2014). Knight Piesold Ltd. also notes that, based on available information, a formal Dam Safety Review has not been prepared for the facility (KP 2014). The CDA recommends that a Dam Safety Review should be performed every five years for Very High consequence dams. A Dam Safety Review is suggested for 2015.

3.3 Observations from Site Visit

Photographs from the October 21, 2014, site visit are presented in Appendix A.

Observations that present potential dam safety concerns include the following:

- The channel spillway at the dam centre line is clear of vegetation, but the channel connecting the small pond in the Lower Tailings Pond to the channel spillway should be cleared of vegetation. The concrete spillway structure was generally clear of vegetation, but the inlet channel should be checked and cleared of debris, as needed (it is understood this was cleared on October 21, 2014).
- The downstream slopes of both the Upper Tailings Dam and the Lower Tailings Dam are covered in trees. While this is not considered to be a concern for the structures at Giant Nickel, it is recommended that the trees be cleared to allow inspection of the toe of the dams.

4.0 FINDINGS AND RECOMMENDATIONS

4.1 General Findings

The general findings of Golder's review are as follows:

- The DSI report (KP 2014) prepared by Knight Piesold Ltd. generally addresses the elements required by the BC MEM (2012), with the exception that there was no review of the 2014 climate data and no current or updated water balance for the facility.
- The dam consequence classification appears appropriate.
- The DSI report (KP 2014) provides an interpretation of the impact of recent updates to the CDA guidelines with respect to the Giant Nickel facility. The report describes the current status and performance of the tailings dams and suggests actions to address requirements set out in the new guidelines from October 2014 (CDA 2014). The DSI also suggests a Dam Safety Review be completed for the facility.

4.2 Prioritization of Recommended Action Items

Several actions are recommended by KP (2014) to reflect the new CDA (2014) guidelines for closed – passive care facilities. The recommendations are reasonable and will enhance the safety of the tailings facility and dams.

Golder notes that none of recommendations relate to immediate dam safety concerns, and the recommendations should be managed in 2015.

5.0 REPORT CLOSURE

We trust that this Independent Review of the 2014 Dam Safety Inspection report for the Giant Nickel mine tailings dams (KP 2014) meets your requirements. Please contact the undersigned if you require additional information regarding this review.

GOLDER ASSOCIATES LTD.

Reviewed by:

John Hull, P.Eng.
Principal, Senior Engineer

Ben Wickland, Ph.D., P.Eng.
Associate, Senior Geotechnical Engineer

JH/BW/kp

o:\final\2014\dynamics numbers - mining division\1412161\1412161-003-r-rev1-2000\1412161-003-r-rev1-2000-giant nickel dsi review 26nov_14.docx

REFERENCES

APEGBC (Association of Professional Engineers and Geoscientists). 2014. *Professional Practice Guidelines – Legislated Dam Safety Reviews in BC*, V2.0 Revised March 2014.

BC MEM (British Columbia Ministry of Energy and Mines). 2012. *Dam Safety Review Guidelines.* Version 3. Ministry of Energy and Mines Dam Safety Section. Victoria, BC, November 2012.

BC MEM. 2014. *Notification of Chief Inspector's Orders – Tailings Dams – Independent Review of Dam Safety and Consequence Classification.* Ministry of Energy and Mines Health, Safety and Permitting Branch. August 18, 2014.

BC MEMPR (British Columbia Ministry of Energy, Mine and Petroleum Resources). 2008. *Health, Safety and Reclamation Code for Mines in British Columbia.* Mining and Minerals Division, Victoria, British Columbia.

CDA (Canadian Dam Association). 2007. *Dam Safety Guidelines.*

CDA. 2013. *Dam Safety Guidelines 2007 (revised 2013)*.

CDA. 2014. *Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams*.

KP (Knight Piesold Ltd.). 2014. *Barrick Gold Inc. Giant Nickel Mine Tailings Facility 2014 Dam Safety Inspection Report*. VA101-93/4-1. Rev. A. September 20, 2014.

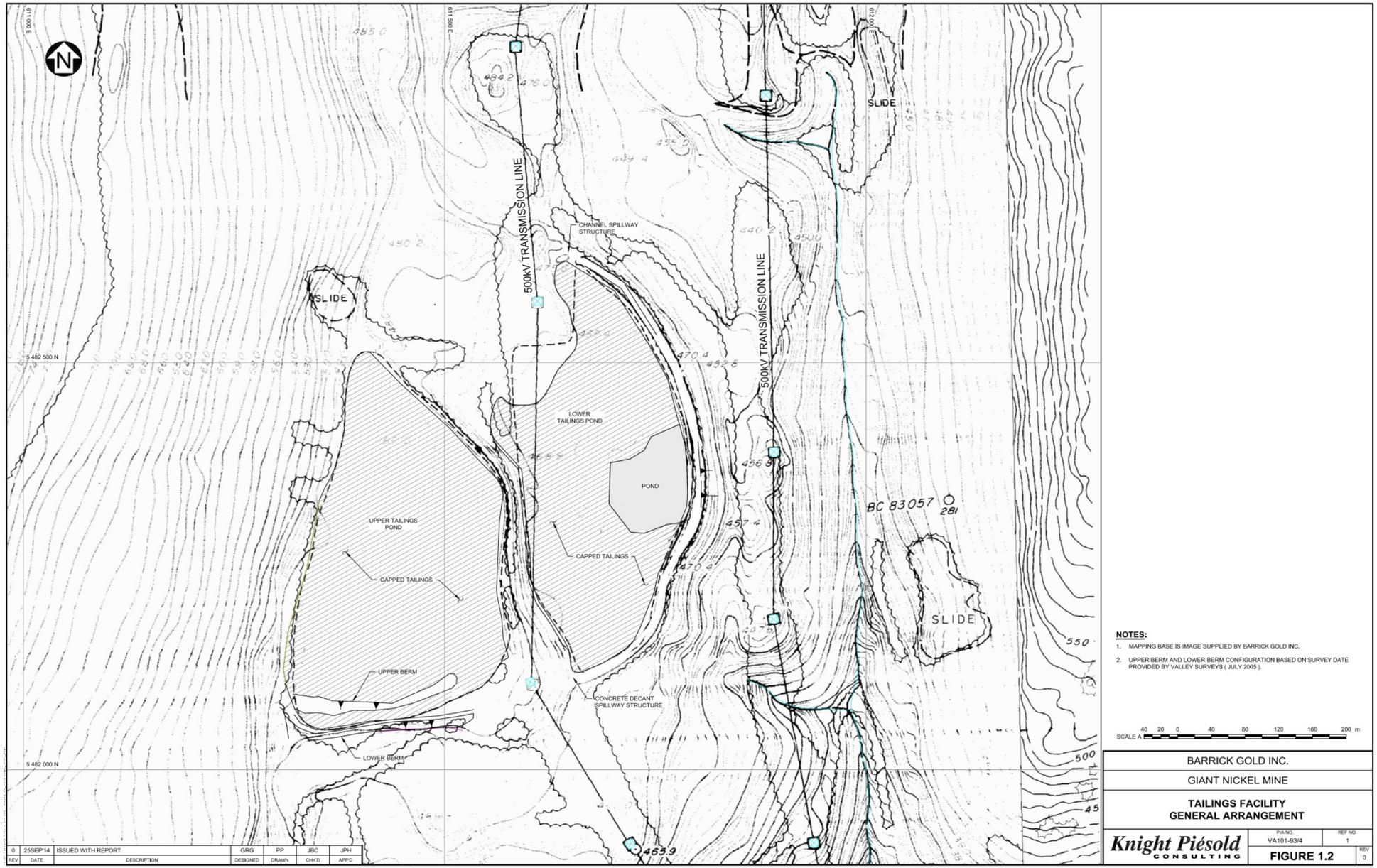

Figure 1: Tailings Facility – General Arrangement

Source: KP (2014).

APPENDIX A

Photographs

APPENDIX A
PHOTOGRAPHS

Photograph 1: Channel Spillway at North End of Lower Dam, October 21, 2014

Photograph 2: Channel on Lower Pond to Spillway, October 21, 2014

Photograph 3: Downstream Slope, Lower Dam, October 21, 2014

Photograph 4: Dwelling at Highway, October 21, 2014

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

Golder Associates